DELPHI

June 5, 2006

United States Environmental Protection Agency, Region 5
77 West Jackson Boulevard, DE-9J
Chicago, IL 60604-3590

Attention: Mr. Kenneth Bardo

Subject: Revised Corrective Measures Proposal
Delphi Corporation
Energy & Chassis Systems and Safety & Interior Systems Facility
Vandalia, Ohio
US EPA ID #OHD 052 151 701
US EPA ID #OHD 000 048 454

Dear Mr. Bardo:

Delphi is pleased to provide the enclosed Corrective Measures Proposal (CMP), prepared for Delphi by Haley & Aldrich, Inc. As you are aware, Delphi originally submitted a CMP in January 2006 in accordance with RCRA 3008(h) Administrative Order on Consent, Docket No. R8H-5-02-001, January 22, 2002. This revised CMP was prepared in response to your comment letter dated April 20, 2006.

We intend to prepare a summary document that will provide both additional clarification to address EPA's comments and a guide to where comments are addressed in the revised CMP. This document will be provided to you no later than June 12, 2006.

Feel free to contact me at (937) 455-0941 if you have any questions or require additional information.

Sincerely,

W. John Ridd

W. John Ridd
Project Manager
Delphi Corporation

**RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
CORRECTIVE MEASURES PROPOSAL
Revised June, 2006**

**DELPHI CORPORATION
ENERGY & CHASSIS SYSTEMS AND
SAFETY & INTERIOR SYSTEMS**

VANDALIA, OHIO

**U.S. EPA ID # OHD 052 151 701
U.S. EPA ID # OHD 000 048 454**

by

**Haley & Aldrich, Inc.
Dayton, Ohio**

for

**Delphi Corporation
Vandalia, Ohio**

**File No. 79022-188
June 2006**

EXECUTIVE SUMMARY

This Corrective Measures Proposal (CMP), prepared in accordance with a 2002 Administrative Order on Consent, evaluates corrective measures alternatives and recommends the proposed corrective measures for the Delphi Corporation Energy & Chassis and Safety & Interior Systems Facility (Facility) in Vandalia, Ohio.

Final corrective measures incorporate the following elements:

On-Site:

- Institutional control (IC) to prevent development of the site for uses other than commercial/industrial, consistent with assumptions from the baseline risk assessment.
- Building operation IC to require operation of current HVAC, or equivalent, at any on-Facility location where vapor migration to indoor air is a potential concern, to prevent accumulation of constituents in indoor air that may pose unacceptable risk.
- IC requiring maintenance of Excavation Policy to minimize potentially unacceptable exposures to shallow groundwater and DNAPL, and restoration of building floor slabs in certain areas of the site to mitigate potential increases in vapor migration from subsurface soil or groundwater.
- Groundwater use IC to prevent on-site use of bedrock groundwater.
- Continuation of groundwater migration controls in the overburden and bedrock zones
- Monitoring of groundwater to ensure migration control systems maintain plume stability.
- Monitoring of indoor air location where vapor migration to indoor air is a potential concern, to ensure vapor migration does not result in unacceptable indoor air concentrations. If a new building is constructed in an area of potential concern, then the need for continued monitoring will be re-evaluated based on the type of HVAC and/or vapor intrusion mitigation that is incorporated into the new building design.

Off-Site:

- Monitoring of groundwater to ensure migration control systems maintain plume stability
- Groundwater use IC to prevent off-site use of bedrock groundwater within and surrounding the existing plume

Final corrective measures for specific areas associated with the Facility include:

AOI 15/AOI 50 –Combination of operating the Facility HVAC system, or equivalent control to mitigate potentially unacceptable indoor air concentrations, with an industrial land use restriction at the Facility and continued enforcement of the Facility's excavation policy.

AOI 43 –Combination of operating the Facility HVAC system, or equivalent control to mitigate potentially unacceptable indoor air concentrations, with an industrial land use restriction at the Facility and continued enforcement of the Facility's excavation policy.

AOI 45 –Combination of operating the Facility HVAC system, or equivalent control to mitigate potentially unacceptable indoor air concentrations, with an industrial land use restriction at the Facility and continued enforcement of the Facility's excavation policy.

Overburden Groundwater –Combination of overburden groundwater migration control with an industrial land use restriction at the Facility and continued enforcement of the Facility's excavation policy.

Bedrock Groundwater - Combination of bedrock groundwater migration control (which has proven successful as an interim measure) with a groundwater use restriction at the Facility and in the surrounding area through City Ordinance and deed restrictions.

Groundwater, indoor air and institutional controls will be monitored into the future in accordance with the proposed monitoring plan included with this CMP.

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LIST OF ACRONYMS AND ABBREVIATIONS

ANPR	Advance Notice of Proposed Rulemaking
AOI	Area of Interest
bgs	Below Ground Surface
BUSTR	Bureau of Underground Storage Tank Regulations (Ohio Fire Marshal)
CA725	RCRA CA725 Environmental Indicator Report
CA750	RCRA CA750 Environmental Indicator Report
CMP	Corrective Measures Proposal
CM	Corrective Measures
DNAPL	Dense Non-Aqueous Phase Liquid
cm/sec	Centimeter per Second
EI	Environmental Indicator
ENVIRON	ENVIRON International Corporation
GM	General Motors Corporation
gpm	Gallons per Minute
GWMC	Bedrock Groundwater Migration Control
Haley & Aldrich	Haley & Aldrich, Inc.
HDPE	High Density Polyethylene
HVAC	Heating, Ventilation, and Air Conditioning
IC	Institutional Control
IM	Interim Measure
LLC	Limited Liability Corporation
LNAPL	Light Non-Aqueous Phase Liquid
MCCHD	Montgomery County Combined Health District
MCL	Maximum Contaminant Level
NAPL	Non-Aqueous Phase Liquid
NPDES	National Pollutant Discharge Elimination System
OBMC	Overburden Migration Control
ODNR	Ohio Department of Natural Resources
PCE	Tetrachloroethene
PLC	Programmable Logic Controller
POTW	Publicly-Owned Treatment Works
PPM	Parts Per Million
PTI	Permit to Install
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSE	Remediation System Evaluation
SVE	Soil Vapor Extraction
TCE	Trichloroethene
μg/L	Micrograms per Liter
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VAP	Voluntary Action Program (Ohio EPA)
VOC	Volatile Organic Compound

1. INTRODUCTION

This Resource Conservation and Recovery Act (RCRA) Corrective Measures Proposal (CMP) was prepared in accordance with Section 18 of the 2002 3008(h) Administrative Order on Consent (Order) for the Delphi Corporation Energy & Chassis and Safety & Interior Systems Facility (Facility) in Vandalia, Ohio. This document has been prepared by Delphi Automotive Systems LLC, a wholly-owned subsidiary of Delphi Corporation (Delphi) for the United States Environmental Protection Agency (USEPA). This CMP evaluates corrective measures alternatives and recommends the proposed corrective measures for addressing contaminated environmental media identified at the Facility during the RCRA Facility Investigation (RFI).

This CMP summarizes Facility background information that was previously submitted to USEPA in the Facility's RFI Report (Haley & Aldrich, 2005) and in other documents that comprise the Facility's administrative record. A CMP was originally submitted in accordance with an agreed-to schedule in January 2006. This document represents a revised CMP that is intended to address comments made by USEPA in April 2006.

As documented in prior reports and summarized herein, Delphi has focused on risk mitigation through interim measures since assuming control of the Facility in 1999. Several of these interim measures were initiated voluntarily before formal Corrective Action began with the 2002 Administrative Consent Order. Throughout the execution of the RCRA Corrective Action program, additional interim measures have been undertaken. The effectiveness of existing interim measures has been thoroughly evaluated, and is well documented in the RCRA CA725 Human Health Environmental Indicator Report (ENVIRON, 2003) and the RCRA CA750 Groundwater Stabilization Environmental Indicator Report (Haley & Aldrich, 2004b).

In addition, a USEPA contractor independently evaluated interim measures and the overall site closure strategy as part of a Remediation System Evaluation (RSE) for the Vandalia Facility. As documented in the RSE report (GeoTrans, 2003), "the RSE team observed a well-managed remedy for the site". Based on the RSE document review and site visit, the RSE team concluded that "Delphi, their contractors, and the EPA (site team) all had an excellent understanding of the complex site conditions, IMs, ongoing investigation, and potential risks".

1.1 Purpose

The purpose of this CMP is to identify and evaluate potential corrective measures alternatives, and recommend the final corrective measures that are necessary to protect human health and the environment under current and reasonably expected future land use at and around the Facility.

This CMP is organized in sections, as follows:

Section 1 – Introduction
Section 2 – New Developments Since RFI Report
Section 3 – Corrective Measures Evaluation Criteria and Criteria
Section 4 – Corrective Measures Alternatives
Section 5 – Evaluation of Corrective Measures Alternatives
Section 6 – Monitoring Plan
Section 7 - References

1.2 Facility Background Information

1.2.1 Historical Development

Prior to 1941, the undeveloped area that became the Facility was in residential and agricultural uses. The Facility was first industrially developed in 1941 by the Aeroproducts Division of General Motors Corporation (GM). The Aeroproducts Division utilized the western portion of Building 31 and Building 33 in the western portion of the southern tract for manufacturing and testing of airplane and helicopter blades and parts from 1941 until 1958.

The Facility was idle from 1958 until 1961. Subsequently, the Inland Manufacturing Division of GM restored manufacturing operations to the southern tract of the Facility. Additional development of the southern tract (i.e., construction of Building 47, Building 48, Building 48A, Building 48B, and Building 48C) occurred from the mid-to late-1960s to the early-1970s as operations expanded. Products manufactured at the Facility since 1961 have included the following: brake hoses, brake hose couplings, asbestos brake linings, foam seat pads, coated vinyl sheeting, ball joints, steering wheels, steering wheel covers, air bags, instrument panels, and rubber bumpers.

The names of the GM divisions operating automotive component manufacturing on the southern tract have changed several times since 1961. The GM divisions that have operated at the Facility include the following: Inland Manufacturing Division (from the early-1960s through late-1970s); Inland Fisher Guide Division and the Delco Chassis Systems Division (from late-1970s to the early-1990s); and Delphi Chassis Systems Division and Delphi Interior & Lighting Systems Division (from the early-1990s to 1999). Delphi Automotive Systems LLC and its parent company, Delphi Automotive Systems Corporation (now Delphi Corporation), were spun-off from GM in May 1999 and continued to operate the two divisions at the Facility as Chassis Systems and Interior & Lighting Systems, respectively, until 2002 when the divisions were renamed Energy & Chassis Systems and Safety & Interior Systems. In 2004, the Safety & Interior Systems was renamed Thermal and Interior Systems.

The northern tract was partially developed in the 1970s for railways. Current use of the northern tract is for overflow parking during the annual United States Air and Trade Show at the James M. Cox Dayton International Airport (Dayton Airport).

1.2.2 Location and Physiography

The Facility is located at 480 North Dixie Drive Highway and 250 Northwoods Boulevard in Vandalia, Ohio, and covers approximately 136 acres in two tracts of land (see Figure 1). The northern tract is approximately 54 acres located north of Northwoods Boulevard, which is partially developed for railway access. The southern tract contains the two Delphi manufacturing plants operated by the Delphi Energy & Chassis Systems (38 acres) and the Delphi Thermal & Interior Systems (44 acres) divisions, respectively.

1.2.3 Land Use and Demographic Data

The Facility is located in a mixed industrial, commercial, residential, and agricultural area. The Dayton Airport is adjacent to the western boundary of the Facility across North Dixie Drive. The airport and light industrial facilities are present in the surrounding area northwest of the Facility. Fields, wooded land, residential and commercial properties, and railways are in the surrounding area north and northeast of the Facility. Interstate I-75 and a Dayton Power and Light electrical substation are adjacent to the eastern boundary of the Facility. Fields, wooded land, commercial and agricultural properties are located immediately east of Interstate I-75. Residential neighborhoods are adjacent to the south and southeast of the Facility. Commercial properties and residences are adjacent to, and in the surrounding area southwest of the Facility.

1.2.4 Geologic Setting

The Facility is located in the Till Plains section of the Central Lowland physiographic province (Norris and Spieker, 1966). The strata in this area are typified by interbedded layers of glacial till and glacial outwash sand and gravel lacking horizontal continuity, overlying limestone and shale bedrock.

The glacial till and outwash were deposited during the Illinoisan and Wisconsin-age glacial events. Typically, the upper glacial till is oxidized and brown to red-yellow in color, with the lower portions of till unoxidized and generally gray to green-gray in color. Thickness of the till and outwash deposits varies considerably from a few feet to over 200 feet in the Dayton area (Norris and Spieker, 1966). Subsurface explorations encountered approximately 40 to 60 feet of glacial deposits at the Facility. Natural surficial soils present at the Facility consist of the Brookston-Crosby association described as deep, nearly level to gently sloping, very poorly-drained and somewhat poorly-drained soils that have moderately fine-textured subsoil. These soils were formed in thin loess and glacial till deposits (Davis, et al, 1976).

The Facility is located near the crest of the Cincinnati Arch and is underlain by rocks of late Ordovician and Silurian Age. These rocks predominantly consist of limestone, dolomite and shale. The rocks encountered beneath the Facility include the Dayton Dolomite, the Brassfield Formation (primarily dolomite), Belfast Transition Unit (a silty, clayey, dolomite) and the Elkhorn Shale.

The subsurface profile at the Facility generally consists of 40 to 50 feet of glacial drift over approximately 40 to 70 feet of dolomites of the Dayton Dolomite and Brassfield formations.

These dolomites overlie approximately 75 feet of the Elkhorn Shale. The glacial drift at the Facility consists primarily of till with sandy and silty lenses.

The Dayton Dolomite is the uppermost bedrock formation encountered at the Facility. Approximately 10 to 20 feet of the Dayton Dolomite are present with the top few feet being fractured and weathered. The lower Dayton Dolomite is less fractured and contains occasional weathered shale beds. Approximately 30 to 45 feet of the Brassfield Formation lie below the Dayton Dolomite. The Brassfield Formation is divided into the "upper" and "lower" units. The upper Brassfield is generally light pink, and occasionally light gray, white or greenish with occasional fractures and glauconitic clay-filled stylolites. The lower Brassfield is white, and has occasional fractures and glauconitic clay-filled stylolites. The transition between the upper and lower Brassfield is gradational. The lowest few feet of the lower Brassfield have been found to be very porous in some areas and are called the "Sugar Rock" by local drillers. The Belfast Transition Unit underlies the Brassfield and is a clayey dolomite that marks a depositional transition between the more permeable carbonates of the Brassfield Formation and the less permeable Elkhorn Shale. The Belfast is a hard and fractured formation which has a gradational transition to the Elkhorn Shale below it. The Elkhorn is green, glauconitic, marine shale that can be soft to hard and has occasional red beds.

1.2.5 Hydrogeologic Setting and Groundwater Use

Overburden groundwater flows primarily through silt and sand layers within glacial till. Groundwater is generally encountered within 10 feet below the ground surface. Horizontal groundwater flow in the overburden is generally toward the northeast. Hydraulic conductivity in the overburden, based on rising head testing, has a geometric mean of approximately 3.6×10^{-5} cm/sec, with a range from approximately 6.9×10^{-7} to 3.5×10^{-3} cm/sec.

Three hydrostratigraphic units have been encountered in the overburden: Shallow, First Sand, and the Second Sand. The Shallow unit is generally within 0 to 5 feet below ground surface (bgs), but may be as deep as 10 feet bgs, and represents the water table. The First Sand is found approximately 10 to 15 feet bgs and is generally 1 to 3 feet thick where present; it is not continuous across the Facility. The Second Sand is found approximately 20 to 30 feet bgs and is also generally 1 to 3 feet thick; however, multiple sand layers, which can span nearly 10 feet in thickness, have been found to be present at this depth.

The "Top of Rock" unit is the fractured and weathered upper Dayton Dolomite and the unconsolidated sand, gravel, cobbles and boulders which directly overlie the bedrock. The groundwater in this unit is confined above by the low-hydraulic conductivity overburden, and below by the clayey beds of the lower Dayton Dolomite and the upper Brassfield. Hydraulic conductivity in the Top of Rock unit, based on rising head testing, ranges from 6.2×10^{-5} to 1.6×10^{-3} cm/sec. Groundwater flow is generally to the northeast with a depression in the vicinity of monitoring well MW-424S (Figure 2). The cause of this depression is unknown; however, it has been a consistent feature for the duration of monitoring in this area.

Of the 43 borings that have penetrated the Brassfield Formation, three encountered localized flow zones of sufficient yield to justify well installation. Subsequent monitoring of these "Middle Brassfield" wells indicated water levels consistent with deeper Sugar Rock wells.

This is strong evidence that the Middle Brassfield flow zones are directly connected to the deeper Sugar Rock.

The next lower hydrostratigraphic unit is in the lower Brassfield Formation and Belfast Transition Unit. This unit is also referred to as the "Sugar Rock" unit. The piezometric surface in this unit is generally 25 to 40 feet lower than the water level in the Top of Rock unit. Rising head tests from wells in the "Sugar Rock" are consistent with the water pressure testing results and indicate horizontal hydraulic conductivity on the order of 10^{-3} to 10^{-4} cm/sec. General groundwater flow in the Sugar Rock under natural (non-pumping) conditions is toward the east. Under current conditions, groundwater is captured by the bedrock groundwater migration control system (described in more detail in Section 1.5.1); during continuous pumping conditions, a potentiometric low is created to locally inhibit eastward groundwater flow. Water pressure testing indicates hydraulic conductivity on the order of 10^{-4} to 10^{-2} cm/sec for the Sugar Rock unit (Haley & Aldrich, 1999a, 1999b).

Underlying the Sugar Rock is the Elkhorn Shale. The US Geological Survey has characterized this formation at the nearby Wright Patterson Air Force Base with 12 wells completed in this Ordovician Shale. Based on the results of their investigation, they describe the Ordovician shale as "virtually impermeable" (USGS, 1993). Delphi has characterized the upper portions of the Elkhorn shale with water pressure testing at over 30 locations. Hydraulic conductivity is consistently low with a geometric mean of 4.16×10^{-7} cm/sec. Based on the observed low hydraulic conductivity of this unit, the Elkhorn Shale provides a lower hydraulic boundary for the regional bedrock groundwater flow system.

A groundwater use survey (Haley & Aldrich, 2002a) was conducted in 2001 within a one-mile radius of the Facility. The groundwater use survey is described in more detail in Section 1.5.3. No records of wells completed in the Overburden units were identified; the hydrogeologic units of significance are the Top of Rock and Sugar Rock. Over 50 residences and businesses were identified as using bedrock groundwater for potable and/or non-potable uses. The majority of these wells are located north and east of the Facility. All water for potable and non-potable use at the Facility itself is supplied by the City of Dayton, which obtains its water from the Great Miami Buried Valley Aquifer.

1.2.6 Surface Water Hydrology

Based on the regional and Facility topography, surface water drains to the northeast and east. All surface water drainage from the Facility discharges to either the unnamed tributary to the North Creek (unnamed tributary) or to the East Creek.

The unnamed tributary originates near the intersection of Northwoods Boulevard and North Dixie Drive from a storm sewer that discharges at this location. The storm sewer drains an area north and west of the Facility. The unnamed tributary flows to the east and northeast, and combines with other creeks of equal or greater size (i.e., the North Creek) before eventually discharging to the Great Miami River. The unnamed tributary flows across the northern tract of the Facility; however, it receives water from the southern tract of the Facility via an NPDES outfall and from property west of the Facility.

The East Creek originates near the eastern Facility property boundary. In addition to receiving discharge from a Facility NPDES outfall, the East Creek also receives water from a storm sewer that drains a large residential area adjacent and south of the Facility. The East Creek flows east and northeast before entering the Great Miami River without joining any other significant streams. East of the Facility, East Creek flows beneath Interstate 75 and across commercial properties. The creek receives stormwater runoff from I-75, and from the roadways and parking lots located at the commercial properties.

1.2.7 Ecological Setting

Ecological reconnaissance was performed at the Facility and surrounding area in August, 1998 by Exponent, Inc. This section summarizes the results of their reconnaissance. For the purposes of this discussion, the Facility and surrounding areas are divided into the following four general areas:

- Manufacturing Plant Area - Delphi property south of Northwoods Boulevard
- East Creek – the storm water receiving channel that originates in the southeast corner of the Facility
- Undeveloped Area (North Tract)- Delphi property north of Northwoods Boulevard
- unnamed tributary - the creek running through the Undeveloped Area (North Tract) and discharges to the North Creek

The Manufacturing Plant Area is largely covered with buildings, gravel, and pavement. Interspersed among the buildings and storage yards and around the perimeter of the Plant Area are a few small areas of maintained vegetation (i.e., mowed grass, and some decorative shrubs and trees). The Manufacturing Plant Area offers limited, low-quality habitat, if any, for wildlife.

The East Creek is a storm water channel; its primary source of water is the combined outfall for storm water from the southeast portion of the Facility and from the residential area immediately south and adjacent to the Facility. At the time of the Exponent site visit, the Great Miami River was at or above flood stage, yet the East Creek was not flowing. In fact, most of the channel was dry with only a few isolated pools. No fish or crayfish were observed in the East Creek, and the aquatic macro invertebrate community was limited. Exponent concluded these observations are consistent with the characteristics of typical storm water receiving areas. Characteristics of typical storm water receiving channels include dramatic fluctuations in water flow rates and volume, channelized streambeds, and bank erosion. These conditions create adverse conditions for most aquatic species and generally provide unsuitable habitat. Consequently, Exponent concluded that East Creek is low-quality habitat for wildlife.

The Undeveloped Area consists of two distinct sub-areas: the mowed grass areas on the west side; and the naturalized habitats on the east side. The mowed grass area may provide some habitat for certain insectivorous birds and certain grassland species of small mammals, such as field mice and meadow voles. The east side of the undeveloped area offers higher quality habitat than the west side. The east side has early to mid-successional fields with mature trees and diverse under story vegetation. Deer tracks and deer bedding areas were observed, and

raccoon and opossum tracks were observed in this area during the Exponent site reconnaissance.

The unnamed tributary, from the Facility to the Interstate I-75 right-of-way, is a channel 1 to 12 inches deep and 3 to 6 feet wide. This section of channel is bordered by a dense growth of woody shrubs and young trees. Within the creek channel, generally no submerged or emergent aquatic vegetation exists. Young-of-the-year crayfish and an adult frog were observed in this section of the creek. No fish were observed and none are expected to occur in this reach of the unnamed tributary because of the nearly 50-feet waterfall that occurs approximately 1 mile downstream (northeast) of the Facility. The waterfall is a physical barrier that prevents upstream movement of fish from the lower reaches of North Creek. Fish were abundant in the downstream reaches of North Creek. Thus, although the downstream reach of North Creek provides good habitat typical of a low-order stream, the reach of the unnamed tributary immediately downstream of the Facility (i.e., the upper reach) provides only limited low-quality habitat for certain types of aquatic organisms. In addition, the upper reach of the unnamed tributary exhibited certain characteristics typical of storm water receiving areas.

1.3 Summary of RFI Findings

1.3.1 RFI Summary

The RFI was conducted at the Facility to fulfill one of the requirements of the Order. The RFI was conducted at the Facility in a phased approach, with three phases of investigation conducted during the period of July 2002 through October 2004. Field investigations focused on the 41 areas of interest (AOIs) designated for investigation in the RFI Work Plan (Haley & Aldrich, 2002d), and two additional AOIs identified during the implementation of the RFI. The findings of the investigations were communicated to USEPA through data reports, meetings and conference calls.

The RFI was designed to evaluate site conditions; to determine whether a release of hazardous waste or hazardous constituents has occurred; and where a potentially significant release is identified, to characterize the nature and extent of hazardous constituents in the environmental media. After each phase of RFI investigation, the adequacy of the data was evaluated to determine whether additional data collection was warranted. As indicated above, three field events were conducted to collect soil, surface water, indoor air, groundwater, and sediment data necessary to achieve RFI objectives (Haley & Aldrich, 2002e, 2003, 2004a). When data of sufficient quality and quantity had been collected, the data were used to support decisions regarding the need for interim or corrective measures. Human health and ecological risk assessments are included in the RFI Final Report to provide a basis for determining whether the presence of these hazardous constituents poses an unacceptable risk to human health or the environment that would warrant corrective measures. The findings of these risk evaluations are summarized below.

1.3.2 Summary of Human Health Risk Evaluation

During implementation of the RFI, the sampling results for each area were compared with conservative generic risk-based screening criteria to identify whether a potentially significant

release of hazardous constituents to the environment has occurred and to asses the adequacy of the characterization of these potentially significant releases. As documented in Section 4 of the RFI Report, it was concluded that adequate data has been collected to support a risk evaluation.

The significance of potential exposure to soil, sediment, surface water, groundwater and indoor air at and adjacent to the site was evaluated based on current and reasonably likely future land use and groundwater use conditions. Potential receptors considered in this evaluation included on-site and off-site routine workers, on-site and off-site construction workers, on-site redevelopment workers, on-site maintenance workers, on-site trespassers, off-site residents and off-site recreational users. As discussed in the RCRA CA725 Report, based on data collected as part of the RFI, and considering potential exposure pathways and site-specific conditions, current human exposures were determined to be under control according to the provisions of the RCRA CA725. To evaluate the significance of potential exposures under reasonably expected future conditions, the human health risk assessment conducted by ENVIRON utilized data collected during the RFI field investigations to evaluate whether an identified release of hazardous waste or constituent may cause reasonable maximum exposures to be significant enough in the future to warrant evaluation of corrective measures. Based on RFI data, this risk assessment identified the following potentially significant exposures:

- The potential risks associated with on-site construction worker exposures to overburden groundwater and DNAPL are significant at certain locations, although exposures at these locations are currently controlled by measures required by the Facility's Excavation Policy. However, future exposures to on-site construction workers could be significant if health and safety precautions are not implemented during excavations in the DNAPL area north of Building 31.
- Potential exposures of on-site redevelopment workers to indoor air may be significant during periods when Facility HVAC systems are not operational in certain building areas. In addition, potential exposures of on-site routine workers to indoor air may be significant if building modifications are made and/or HVAC systems are not operated similar to the conditions observed during the RFI.
- The potential risks associated with off-site resident and routine worker exposures to bedrock groundwater resulting from the use of groundwater are currently under control. However, the potential exists for significant exposures from the use of bedrock groundwater if groundwater having concentrations in excess of relevant use criteria (i.e., potable or non-potable criteria) migrate to locations where groundwater is used, or new wells are installed at locations where bedrock concentrations exceed the relevant use criteria.
- Contaminated overburden groundwater is limited to on-site areas, such that exposure of off-site receptors is currently an incomplete pathway. However, the potential exists for significant exposures to off-site receptors (including residents and routine workers via vapor intrusion, and construction workers via direct contact) in the future if contaminated overburden groundwater from the DNAPL area on the north side of Building 31 migrates at concentrations of concern to areas below off-site buildings or to locations where excavations may occur.
- AOI 15/50 has TCE concentrations in soil that may represent a potential concern for VOC migration to groundwater. In addition to contributions of VOCs to groundwater

from overlying soils, residual DNAPL and LNAPL have also been observed on-site and represent a potential continuing source of dissolved phase constituents to groundwater.

1.3.3 Summary of Ecological Risk Evaluation

The potential for exposure of ecological receptors to site-related constituents was evaluated by Exponent for the following study areas: Manufacturing Plant Area, East Creek, Northern Tract, the unnamed tributary to North Creek, and the Sugar Rock Outcrop. The results of the site reconnaissance and habitat characterization, and the information presented by the CA750 Report (Haley & Aldrich 2004b) form the basis for the following conclusions regarding ecological risk:

- There are no complete exposure pathways to potential terrestrial receptors on the Facility. The Manufacturing Plant Area does not provide habitat for ecological receptors; therefore, there is no potential for ecological exposure in this area of the Facility. Although the Northern Tract provides some habitat to potential terrestrial ecological receptors, the absence of releases in this area precludes exposure.
- There are no complete exposure pathways to potential aquatic receptors in the East Creek and the unnamed tributary to North Creek. In the areas where site-related constituents have been measured, these features provide few resources to aquatic receptors. In the vicinity of the site, these drainages are highly modified to accommodate stormwater runoff and are subject to extreme flow fluctuations. In addition, there are downstream barriers to fish passage that preclude any exposure of fish to site-related constituents.
- There is the potential for complete exposure pathways to ecological receptors in water originating from springs in the Sugar Rock outcrop. Site-related constituents were measured in areas immediately downstream of the springs at or below screening level concentrations for aquatic receptors. These areas had poorly developed aquatic communities, and areas that may support ecological receptors, such as fish, are located a considerable distance downstream. Exposure point concentrations in areas with well-developed aquatic communities are expected to be negligible.

Based on these conclusions, no further evaluation of ecological risk was warranted.

1.3.4 RFI Elements for CMP Consideration

Risk assessments performed during the RFI identified areas where concentrations of hazardous constituents in environmental media pose a potential for current or future unacceptable risk. The risk assessment was based on the following assumption: (1) future land use will remain commercial/industrial; and (2) under current conditions, the existing Facility's Excavation Policy specifies procedures to prevent unacceptable exposures during on-Facility excavation activities. Because the conclusions of the RFI rely, in part, on these assumptions, institutional controls are proposed to maintain the current land use and enforcement of the Excavation Policy. USEPA accepts the use of institutional and engineering controls as part of a final remedy in RCRA Corrective Action (USEPA, 2000b and 2000c). It is assumed that the existing Administrative Order on Consent or an implementation order will be amended/established to reflect environmental covenants related

to these restrictions pursuant to the Ohio Environmental Covenants Act (Ohio Revised Code 5301.80 - 5301.92).

Based on the findings of the RFI, the following elements are included in the evaluation of potential corrective measures alternatives of this Corrective Measures Proposal:

- Continued operation and modification, as necessary, of interim measures groundwater migration control systems in the overburden and bedrock to maintain control of off-site migration of groundwater at concentrations of concern;
- Implementation of on-site and off-site institutional controls that are intended to prevent unacceptable exposures to bedrock groundwater;
- Continued on-site and off-site groundwater monitoring intended to ensure that contaminated groundwater does not migrate to potential exposure points at concentrations of concern, and constituents remaining in soil do not adversely impact groundwater such that modification to the groundwater migration control systems would be warranted;
- Implementation of institutional controls intended to prevent unacceptable exposures to on-site soils that could result from changes in on-site land use;
- Implementation of institutional and/or engineering controls along with indoor air quality monitoring in certain on-Facility areas to verify that building ventilation is maintaining acceptable indoor air concentrations; and
- Continued implementation of the Facility's Excavation Policy intended to prevent unacceptable exposures of construction workers to constituents in overburden groundwater or DNAPL.

1.3.5 Soil Areas of Interest (AOIs) for Corrective Measures

As summarized in Section 1.3.2, based on the findings of the RFI, soils in several AOIs are evaluated herein for corrective measures. Specifically, the following AOIs are being evaluated as a result of VOC concentrations in soil which may result in unacceptable exposures via vapor migration to indoor air (VOCs contributing most significantly to the risk estimates are listed for each AOI):

- AOI 15/AOI 50 (cis-1,2-DCE and TCE)
- AOI 43 (naphthalene and 2-methylnaphthalene)
- AOI 45 (vinyl chloride)

In addition, TCE concentrations in AOI 15/AOI 50 represent a potential concern for VOC migration to groundwater, and therefore, this pathway is addressed in Section 5 of this document.

1.3.6 Overburden Groundwater for Corrective Measures

The overburden groundwater units include the Water Table, First Sand and Second Sand. On-Facility groundwater samples collected from each of the three overburden units during the RFI exhibited sufficiently high residual DNAPL and dissolved phase VOC (including cis-1,2-dichloroethene; TCE; PCE; and vinyl chloride) concentrations, such that based on the RFI baseline risk assessment, it is possible that construction workers may encounter unacceptable

exposures during excavations in certain areas in which shallow groundwater concentrations are present at levels of concern or residual DNAPL is present. In addition, unacceptable exposures via vapor migration to indoor air or direct contact by construction workers may occur at off-Facility locations if VOCs migrate in groundwater to off-site areas where this pathway is complete. Accordingly, it is warranted that this CMP evaluate overburden groundwater for corrective measures.

1.3.7 Bedrock Aquifer Groundwater for Corrective Measures

The bedrock aquifer groundwater units include the Top of Rock, Middle Brassfield and Sugar Rock. Groundwater samples collected from each of the three bedrock units during the RFI exhibited sufficiently high VOC concentrations (including cis-1,2-dichloroethene; TCE; PCE; and vinyl chloride), such that based on the RFI baseline risk assessment it is possible that unacceptable exposures may be encountered from the off-Facility use of bedrock groundwater if groundwater having concentrations in excess of relevant use criteria (i.e., potable or nonpotable criteria) migrate to locations where groundwater is used, or new wells are installed at locations where bedrock concentrations exceed the relevant use criteria. Accordingly, it is warranted that this CMP evaluate bedrock groundwater for corrective measures.

1.3.8 Indoor Air for Corrective Measures

As a result of the risk estimates predicted for vapor migration from soil in certain AOIs, this exposure pathway was further evaluated in the RFI using the results of direct measurement of air concentrations collected from locations identified as representing potential worst-case indoor air conditions (i.e., tunnels and sumps). Based on the RFI baseline risk assessment, risk estimates using actual indoor air measurements collected during Facility shut-down period (when the facility HVAC system was not operating) indicate that potential exposures of on-site indoor redevelopment workers could be significant at AOI-16, AOI-15 and AOI-43.

AOI-16 indoor air samples contained 1,2,4-trimethylbenzene, 2-methylnaphthalene and naphthalene at concentrations that could be significant for redevelopment workers. However, these constituents were not detected in soil or groundwater at AOI 16 at levels that could contribute to these indoor air concentrations. In fact, the decision to conduct indoor air sampling at AOI-16 was based on a concern for potential vapor intrusion from concentrations of carbon tetrachloride, chloroform, TCE and vinyl chloride in soil. If vapor intrusion was occurring, these VOCs would be expected to be the predominant chemicals detected in the indoor air samples. However, these chlorinated VOCs were not detected in the indoor air samples. The absence of these chlorinated VOCs in the indoor air samples indicate that vapor intrusion is not occurring at AOI 16, and the presence of 1,2,4-trimethylbenzene, 2-methylnaphthalene and naphthalene in the indoor air samples is likely due to an indoor source. Therefore, corrective measures are not warranted to address potential indoor air vapor intrusion at AOI-16.

AOI-15 indoor air samples contained 2-hexanone, 1,2,4-trimethylbenzene, 2-methylnaphthalene and naphthalene at concentrations that could be significant for redevelopment workers. Similar to AOI-16, these constituents were not found at levels of concern in the soil at AOI 15 and may be the result of chemicals in-use within the facility

rather than from a significant release to soil or groundwater. However, unlike AOI-16, the indoor air samples at AOI-15 did detect TCE and cis-1,2-DCE, although not at concentrations which would contribute significantly to indoor air risk estimates. Again, it was the concern for vapor intrusion from these and other chlorinated VOCs (TCE, PCE and cis-1,2-DCE) in soil that led to indoor air sampling in AOI-15 (see Section 1.3.5). Even though the VOCs detected in the indoor air sample at AOI-15 did not contribute significantly to the risk estimates based on their measured indoor air concentrations, the risk estimated based on indoor air concentrations predicted by conservative vapor intrusion modeling from soil concentrations are sufficiently high that corrective measures to address this pathway are evaluated below in Section 5.

In AOI-43, 1,2,4-trimethylbenzene, 2-methylnaphthalene and naphthalene were found in both the indoor air and soil samples at potentially significant levels. Therefore, corrective measures to address potential vapor intrusion are evaluated below in Section 5.

1.4 Conceptual Model for Contaminant Distribution in Groundwater

As discussed in the RFI, much of the regional VOC-in-bedrock groundwater characterization work has been completed and, as such, an overarching conceptual model for this contaminant distribution was developed. The conceptual model is discussed below.

Given the lateral and vertical complexity of contaminant distribution across the Facility, the actual pathways can not be confirmed. However, the following key factors must be considered to develop a plausible contaminant distribution scenario:

- Concentrations of TCE in MW-424D in the Sugar Rock indicate historic dense non-aqueous phase liquid (DNAPL) in the Sugar Rock zone was and remains the source of groundwater contamination in this unit on site.
- TCE and other solvents were stored in USTs on site. Tank inspections and soil/groundwater sampling indicated that several of these tanks had leaked.
- While TCE is the dominant fraction of the DNAPL observed in Tank Area C and First Sand, several other VOCs (including 1,1,1-trichloroethane; methylene chloride; and carbon tetrachloride) occur in the current First Sand DNAPL "mix." Only rarely during these investigations have these other VOCs been detected in the Sugar Rock groundwater.
- The Top of Rock hydrostratigraphic unit, located vertically between the First Sand and the Sugar Rock, has a relatively limited area impacted by VOCs; again, principally TCE. The VOC-impacted area is essentially centered around an extreme potentiometric low in the vicinity of MW-424S, shown on Figure 2.

These factors support the following contaminant distribution model:

- TCE leaking from USTs or other industrial operations accumulated as DNAPL in the First Sand below Tank Area C.
- The historical TCE-only DNAPL in the vicinity of MW-424S/D was conveyed to the Sugar Rock zone at depth.

- DNAPL in the Sugar Rock produces an eastward-migrating dissolved-phase TCE plume in this zone.

When considering historic factors and the likely contaminant distribution model, the following conclusions can be drawn:

- Further DNAPL recovery or any other remedial measure in the First Sand will have no impact on the Sugar Rock plume because the contaminant connection between the DNAPL observed in the First Sand in Tank Area C and the Sugar Rock aquifer does not currently exist. VOCs currently detected in the residual DNAPL in Tank Area C (1,1,1-trichloroethane; methylene chloride; and carbon tetrachloride) are rarely detected in Sugar Rock groundwater.
- The feature that creates the potentiometric low in the Top of Rock zone, possibly an old water production well, appears to have served as the conduit for DNAPL to the Sugar Rock. However, this feature currently provides beneficial passive capture and control of the VOC plume in the Top of Rock in this area.
- The source of VOCs in the Sugar Rock is likely residual DNAPL present at depth within the Sugar Rock itself prior to DNAPL recovery efforts. Given the slow dissolution rates of TCE caused by matrix diffusion, it is likely this source will sustain for decades.
- Concentrations of TCE above 1% of the aqueous solubility (approximately 10,000 μg/L) are indicative of the presence of DNAPL. MW-424D is the only monitoring well in the Sugar Rock which has ever had detections of TCE above 1% of TCE aqueous solubility. Additionally, as discussed in Section 1.5.1, except in one area of relatively low TCE concentration southeast of the Facility, TCE concentrations in off-site Sugar Rock wells have decreased throughout the plume. If additional source DNAPL existed off-site TCE concentration would not be affected by on-site migration control. These observations show that on-site DNAPL in the Sugar Rock has not migrated off-site.

In the southeast residential and Cassel Road areas the source or sources of VOCs has yet to be conclusively determined. The ratio of TCE to its initial degradation products, cis-1,2-dichloroethene and vinyl chloride, do not match the pattern observed in the plume immediately downgradient of the Delphi Facility, and therefore suggests there may be other non-Delphi sources of VOCs in bedrock groundwater (Figure 3). Additionally, as discussed in Section 1.5.1, TCE concentration trends southeast of the Facility do not follow the general downward TCE trend of the rest of the plume. It is acknowledged that no other source of VOCs in bedrock has been specifically identified as yet. Regardless of the source of VOCs in the existing off-Facility wells, Delphi is committed to the health and welfare of its neighbors and the community as a whole, and as such, Delphi has considered the potential risk of exposure to groundwater in these off-Facility areas via field investigations and data evaluation documented in the RFI report. It is noted that the activities described below do not imply Delphi's responsibility for contamination found in residential wells.

1.5 Interim Measures Summary

Delphi conducted significant site characterization and remediation activities before finalization of the RCRA Corrective Action Consent Order. This work was performed either on a

voluntary basis or under a number of regulatory programs, including Ohio Bureau of Underground Storage Tank Regulations (BUSTR) and Ohio Voluntary Action Program (VAP).

In the late-1980s and early-1990s, the Facility undertook a site-wide UST closure/removal program. Tanks were grouped into areas (identified as Tank Area A through F) and site conditions were evaluated in accordance with BUSTR requirements in effect at the time. Conditions observed at the time of the UST closure program indicated releases of tank contents had occurred at several of the tank areas. Additional soil and overburden groundwater sampling was conducted in the mid-1990s to further characterize the nature and extent of the apparent historic tank releases. Most of the investigation work focused on Tank Areas A through C, which are located on the north side of Building 31, south of Northwoods Boulevard. Shallow subsurface conditions indicated the presence of fill overlying glacial till and two sand layers, the shallow of which was termed the First Sand and the deeper of which was termed the Second Sand. DNAPL was detected in the First Sand in the vicinity of Tank Area C.

In the mid-1990s, the Facility began a relatively broad bedrock groundwater investigation program to further characterize the extent of trichloroethene (TCE), and its breakdown constituents, in bedrock groundwater approximately 100 feet below the Facility (Sugar Rock). This work led to an extensive off-site bedrock groundwater investigation program and preliminary design of a groundwater migration control system (Haley & Aldrich, 2002b). Included in this work were the identification of groundwater users and the types of groundwater use near the Facility. The groundwater use survey included residential, commercial and industrial properties located within an approximately one-mile radius of the Facility. The off-site groundwater investigation program was completed during the RFI. Groundwater monitoring continues with results presented in quarterly summary reports.

Investigations undertaken by Delphi detected VOCs in the overburden groundwater and surface water north of the Facility, and concluded that the primary source of TCE detected in the unnamed tributary to North Creek near the NPDES outfall was groundwater infiltrating into an on-site storm sewer system.

As summarized herein, and based on investigative results and conceptual model estimates, Delphi voluntarily began implementation of six interim measures (IMs) to control releases of hazardous waste or hazardous constituents at and from the Facility. These are listed below and discussed in the following sections.

- Bedrock Groundwater Migration Control. The objective of this system is to control the migration of contaminated bedrock groundwater at the Facility's property boundary.
- DNAPL Recovery System. The objective of this system is to remove, to the extent practicable, free DNAPL from the First Sand unit underlying the former Tank Area C.
- Groundwater Use Survey. The objectives of this survey were to identify groundwater users and types of groundwater use, to collect samples for analytical testing from active groundwater wells, and to further assess the limits of potential VOC impact.

- Residential Public Water Supply Line Connections. The objectives of the Residential Public Water Supply Line Connection project were to provide municipal water supply to the identified homes on Cassel Road and to eliminate the use of private water wells by these residents.
- Storm Sewer Replacement. The objective of this project was to eliminate VOCs from the Facility's North Outfall.
- Overburden Migration Control. The objective of this system is to control migration of VOC-impacted groundwater in the overburden area.

1.5.1 Bedrock Groundwater Migration Control

In late 1999, Delphi installed a Bedrock Groundwater Migration Control (GWMC) system as an IM to address the migration of VOC-impacted groundwater in bedrock. More detail on this system is provided in the Interim Measures and Implementation Report - Groundwater Migration Control (Haley & Aldrich, 2002b). The GWMC system extracts groundwater from a single well located in the northeast corner of the Facility, installed in the bedrock aquifer. Extracted groundwater is pumped to a treatment building where VOCs are removed by an air stripper. Treated groundwater is then discharged in accordance with the Facility's NPDES permit. The GWMC system has been fully operational since April 2000. Some down-time has occurred due to repairs and maintenance. The GWMC system has been operational approximately 91% of the time since it came online in April 2000. More recently, system up-time has further improved. Since January 2004, the system's continuous operation has increased to 98.3%.

A Programmable Logic Controller (PLC) records at five-minute intervals system operation data, pumping well water level, influent pumping rate, holding tank water level, air temperature, effluent flow rate, and differential pressures at various phases of treatment. The total daily flow, a reporting requirement for the NPDES permit, is also recorded. Total monthly flow and average daily flow are determined for each month of system operation and reported to Ohio EPA along with system sampling data in accordance with NPDES requirements.

Sugar Rock monitoring wells MW-301D, CSX-18D, MW-413D, MW-414D, MW-416D, MW-417D, MW-418D and MW-420D are located within the capture zone of the Sugar Rock Groundwater Migration Control System (GWMC). Five of these wells (MW-301D, MW-413D, MW-414D, MW-418D and MW-420D) have had a greater than 93% reduction in total VOC concentration from their pre-migration control start-up sampling in April 2000 to their most recent sampling. All of these 8 monitoring wells have had a reduction in total VOC concentration. Total VOC reductions were calculated by summing all detected VOCs.

Other Sugar Rock monitoring wells down-gradient of and outside the capture zone of the Sugar Rock GWMC system have shown reductions in total VOCs from their pre-migration control start-up sampling in April 2000 to their most recent sampling. Monitoring wells MW-432D, MW-435D and MW-436D have had total VOC reductions of greater than 94%. Other significant reductions have occurred at MW-408D, MW-410D, MW-411D, MW-412D MW-419D, MW-434D and MW-437D. TCE concentration vs. time plots for Sugar Rock monitoring wells which are in the VOC plume can be found in Appendix A.

Appendix B presents an analysis of normality for Sugar Rock TCE data. Results of this analysis indicate a variety of distributions including normal, log-normal, and non-distributed data. Because of the varying distributions observed in the data, the Mann-Kendall non-parametric analysis (Gilbert, 1987) was used to evaluate TCE trends. Appendix A and Figure 17 presents the results of the Mann-Kendall analysis of TCE in Sugar Rock monitoring wells. According to the Mann-Kendall trend analysis of 33 TCE in Sugar Rock trends, 26 (79%) show a statistically significant decrease in concentration, six (18%) show trends that can not be significantly determined to be increasing or decreasing (i.e. no trend), and one well shows an increase in TCE since the start of migration control in April 2000. As presented on Figure 17, all wells immediately downgradient of the migration control system (near MW-301D) have statistically significant decreasing trends in TCE concentrations demonstrating the effectiveness of the system. One well, MW-407D, located approximately 1500 feet east of the migration control system, did not shown a statistically discernible trend. The remaining wells where non-decreasing trends are observed occur in two distinct groups. One of these groups consisting of two "no-trend" wells (MW-422D and MW-242D) is on the Facility upgradient of the GWMC in the area where DNAPL was likely originally emplaced in the bedrock. Another group consisting of two no-trend wells and one increasing trend is present approximately 2,000 feet south-southeast of the Facility boundary. These wells also occur in an area where, as discussed in Section 1.4 above, TCE/DCE ratios do not match the pattern expected of TCE that has migrated a significant distance from its point of release. The increasing and non-decreasing trends provide further evidence of another potential area of release in the vicinity of these wells (Figure 17).

Coupled with the potentiometric data collected, these VOC trends clearly show the migration control system is meeting design goals.

Since the GWMC system was placed online, routine effluent samples have been collected to evaluate the effectiveness of groundwater treatment. The GWMC system has remained compliant with NPDES discharge requirements over the course of its operating history.

1.5.2 DNAPL Recovery System

In 1998, as an IM, bids were solicited to install and operate a mobile vacuum-enhanced DNAPL recovery system, incorporating the design concepts evaluated during pilot testing. A contractor designed and constructed the DNAPL recovery system. Delphi, following its spin-off from GM in 1999, assumed implementation of the DNAPL recovery system.

The performance goals for the DNAPL recovery system were to:

- remove all recoverable free DNAPL, to the extent practicable, from the 13 on-site recovery wells installed in the area and geologic unit with observed DNAPL;
- optimize system up-time for the efficient and timely collection/recovery of free DNAPL; and
- operate the system in compliance with the Permit to Install (PTI) and associated rules.

System startup was initiated in November 2000. Due to the nature of DNAPL occurring in the subsurface, direct measurement of system performance is difficult. Extensive

characterization work was performed to place extraction wells in appropriate locations to capture free DNAPL.

As discussed in the Remediation System Evaluation (RSE) Report (GeoTrans, 2003), initial performance expectations were not achieved because of two primary reasons. First, the electric submersible pump emulsified recovered product, and second, the methanol used to regenerate the resin could not be sufficiently purged from the canister. As a result, the extracted water could not meet discharge requirements and had to be containerized.

These issues were addressed in late 2001 by replacing the existing electrical centrifugal pump with a pneumatic pump and by relocating the drain to the bottom of the resin vessels to facilitate collection of DNAPL. As a result of these system modifications, performance expectations were met.

The system was operated as stated in the Interim Measures and Implementation Report – DNAPL Recovery System (Haley & Aldrich, 2002c) until measurable DNAPL was no longer produced. Measurable DNAPL was defined as free DNAPL sufficient in quantity to be visually observed and/or physically measured (i.e., layer thickness) in the DNAPL chamber of the separator tank. A recovery well was determined to exhibit no measurable DNAPL when no DNAPL had been observed and/or physically measured (in the separator tank) after 72 hours of continuous system operation. Free DNAPL recovery continued until all existing recovery wells (i.e., R-1 through R-4, R-5, R-6 and R-9 through R-15) exhibited no measurable DNAPL.

This process was continued with periodic operation through October 2004. No DNAPL has been measured in the recovery wells since October 2004. During the course of operation, approximately 1,200 pounds of DNAPL were recovered.

After all recovery wells exhibited no measurable DNAPL as discussed above, recovery operations ceased. Since then, recovery wells have been monitored on a quarterly basis for the presence of free DNAPL. If, during any quarterly monitoring event, the presence of free DNAPL is detected, recovery operations will again resume.

1.5.3 Groundwater Use Survey

Delphi undertook the Groundwater Use Survey (Survey) as an additional IM and in accordance with the water use survey work scope presented by the USEPA in the Order. The purpose of the Groundwater Use Survey was to locate and sample private wells, and to collect information regarding well construction. This survey included residential, commercial and industrial property within, but not limited to a one-mile radius of the Facility. Additional information was presented in the Interim Measures and Implementation Report – Water Use Survey Report (Haley & Aldrich, 2002a).

The water use survey was structured in two phases: a door-to-door survey within high priority, potential groundwater use areas; and a written survey performed via mail. The door-to-door survey was completed in July and August 2001.

Five teams of Delphi representatives, each including a Delphi Public Relations representative, a Delphi Environmental representative, and a hydrogeologic subject matter expert from Haley & Aldrich, executed the door-to-door survey in July and August 2001. Each team canvassed a designated area of developed properties within the targeted area to identify potential groundwater users. A questionnaire was used as the preliminary tool to identify locations within the survey area with potential access to groundwater (i.e., groundwater well(s) present). The questionnaires were completed by team members based on interviews with residential occupants or representatives of commercial establishments interviewed during the door-to-door survey. Where a resident or representative was not available, instructions to provide groundwater use information by telephoning a hotline were left at the property. A toll-free hotline was established by Delphi and staffed with personnel qualified to interview callers about private wells. Hot line staff members completed the same water use survey used by the door-to-door teams.

In areas of known or highly suspected groundwater use (Cassel Road, Engle Road, Old Springfield Road and Old Springfield Court), Delphi conducted repeat visits until direct contact was made.

Approximately 800 locations were visited during the first phase of the water use survey. Locations surveyed included homes and businesses on Cassel, Engle and Old Springfield Roads, Old Springfield Court, and a large residential area southeast of the Facility, hereafter referred to as the Southeast Residential Area. All locations identified as having a well present based on the review of Ohio Department of Natural Resources (ODNR) data, Montgomery County Combined Health District (MCCHD) data, and water billing information were surveyed in person by one of the Delphi teams.

The water use survey questions identified whether groundwater was being used at the location and for what purpose (e.g., consumption, washing automobiles, irrigation, etc.). The name, address and telephone number of the occupant of each location surveyed, and the date the survey was completed were recorded on the survey form.

The survey by mail commenced in April 2002. Approximately 1,800 residents were targeted to receive the survey by mail. Recipients were requested to return the completed survey using a self-addressed envelope that was included with the mailing. The mailed surveys were reviewed to identify locations that require further examination. It is noted that mailed surveys were intended for locations up- or side-gradient of the Facility. Other than data collection, no other activities are anticipated for these locations.

Results of the Groundwater Use Survey concluded no one was consuming water containing VOCs above the U.S. EPA maximum contaminant level (MCL). A total of 120 groundwater samples have been collected from 52 residential or commercial locations within the survey area. All groundwater samples were submitted to an EPA-approved independent laboratory for analysis. Ninety-five of the groundwater samples, or 79%, contained no detectable levels of VOCs. VOCs were detected in 25, or 21%, of the samples collected; however, as stated previously, none of the samples collected from points of drinking water consumption (i.e., inside a home or establishment) exceeded MCLs. Of the 25 locations where VOCs were detected, TCE was detected at nine residential or commercial locations.

The Groundwater Use Survey identified one residence where groundwater is used as the primary drinking water source and VOCs were detected. This residence is on Engle Road, northeast of the Facility. All sampling results have consistently been below federal and state MCLs. Municipal water service does not extend to Engle Road. The owner has refused Delphi's repeated offers to install a new shallower well that would not extend into the potentially impacted lower aquifer. The owner has since moved and the residence is currently unoccupied. No other locations on Engle Road had detectable VOCs in water supply wells.

One location near the southern end of Engle Road has been identified with a well that may penetrate the Sugar Rock aquifer. Two samples have been collected at this business located at 880 Engle Road, with no VOCs detected. Other Engle Road locations either have shallower wells in the unimpacted Top-of-Rock aquifer or are located north of the impacted area of the Sugar Rock.

1.5.4 Residential Water Supply Line Connections

As a follow-up to the Groundwater Use Survey, Delphi initiated the Residential Water Supply Line Connection Project for the Cassel Road area, located east of the Facility. As discussed in Section 1.5.3, no samples collected from a point of consumption contained VOCs at concentrations above the MCL. However, due to the presence of VOCs detected in monitoring wells in the vicinity, Delphi elected to connect area residences to the municipal water supply and abandon the private wells. Six area homes on Cassel Road had not previously been connected to the city water supply. Delphi connected five of these private homes to the City of Vandalia public water supply. The City of Vandalia purchases its potable water from the City of Dayton. Dayton draws water from the Miami Valley Buried Aquifer. After connection was completed, the existing water wells serving these homes were permanently closed (i.e., pressure tank, valves, pump controls/power supply removed). Additionally, Delphi abandoned wells at homes where connection to the municipal water supply already existed.

The well abandonment process included deed restrictions prohibiting residents from drilling wells in the future. As of April 2005, three residences along Cassel Road continue to use their wells for non-potable use and have declined well abandonment. One residence on Cassel Road uses their well for potable and non-potable purposes. This location has not had any detection of VOCs, and is sampled semi-annually by Delphi to monitor groundwater quality.

1.5.5 Storm Sewer Replacement

Delphi discharged stormwater runoff and non-contact cooling water to an unnamed tributary to North Creek via an existing storm sewer and under an NPDES permit. During 2000, the Facility's storm sewer system was sampled in both dry and wet weather. Much of the stormwater was from Building 48 roof drains and the Facility's ground-level drainages. This sampling identified concentrations of TCE at approximately 1 part per million (ppm) in the unnamed tributary to North Creek downstream from the outfall and greater than 10 ppm in selected sewers/manholes at the Facility.

To mitigate infiltration of impacted groundwater, a new storm sewer collection and conveyance system was designed and installed in the VOC-impacted areas. The project

included the installation of approximately 1,200 linear feet of overhead storm drains inside Facility buildings, and approximately 1,200 linear feet of new or re-lined HDPE storm sewer outside the Facility buildings.

The new, water-tight storm sewer system was installed in January through February 2001 to handle stormwater that flowed through two existing 18-inch diameter storm sewer lines. The new storm sewer system consisted of an HDPE line and associated fittings, which were heat-welded and pneumatically tested. Figures 4 through 9 show various photos of the installation of the new system. The existing underground storm sewers were left in place with the ends plugged to serve as a potential future collection system for groundwater migration control, if needed.

1.5.6 Overburden Migration Control

During the RFI, continued monitoring of surface water in the unnamed tributary to North Creek indicated a rebound in TCE concentrations downstream from the NPDES outfall. Further investigation in May 2002, including storm sewer manhole sampling, revealed that the previously unimpacted portion of the storm sewer system to the west contained TCE at a concentration of 140 μg/L. Additional sampling in the unnamed tributary to North Creek, the point of discharge for the newly-impacted western sewer identified a rebound in TCE concentrations in the summer of 2002.

An evaluation of groundwater flow conditions in the vicinity of the newly-impacted storm sewer indicated a change in the water table groundwater flow pattern. With installation of the new water-tight storm sewer system (discussed in Section 1.5.5), shallow overburden groundwater was no longer captured by the former leaky concrete sewer system. As a result, VOC-impacted groundwater had migrated north-westerly toward the previously unimpacted older section of the sewer system. This change in groundwater flow was anticipated; and for that reason most of the former leaky sewer system had been left in place at the completion of the replacement project (discussed in Section 1.5.5). With this discovery of the changing overburden groundwater plume, Delphi initiated an IM to control migration of VOC-impacted overburden groundwater in this area, an Overburden Migration Control (OBMC) system.

During design and permitting, an interim recovery system was operated during fall 2003. Water was pumped to a series of frac tanks prior to treatment by a permitted mobile treatment unit. Treated water was discharged to the sanitary sewer with approval of the POTW.

The permanent system included a sump, vault and recovery well installed in the VOC-impacted overburden area at the terminus of the former storm sewer system. Recovered groundwater was then conveyed to the existing bedrock migration control treatment building for treatment. Furthermore, minor system upgrades were necessary to allow the treatment of this additional flow. In July 2003, Delphi received a PTI for the proposed system modifications from the Ohio EPA. Modifications were completed as agreed and in December 2003 the OBMC system was brought on-line.

Since start-up, the system has been operational at least 95% of the time and typically operates greater than 98% of the time. Reasons for system down-time are detailed in the Quarterly Progress Reports submitted to the USEPA. Generally, the causes for system down-time are

equipment-related (e.g., malfunctions, replacements, modifications) or planned operational maintenance (e.g., backwashing, filter changes).

The performance of this system is best demonstrated by its influence on downstream surface water concentrations. As shown on the time series plot for sampling location SW-4 (the first location downstream from the storm sewer outfall in Figure 10), TCE concentrations in surface water began to decline with the initial operation of the temporary recovery system during fall 2003. The permanent system continues to maintain low concentrations of TCE. TCE results from the last year of quarterly sampling have not been above 16 μg/L.

The State of Ohio has a 810 μg/L Water Quality Criteria (WQC) for non-drinking water for human health. TCE results were above the 810 μg/L standard at SW-4 during two consecutive quarterly sampling periods on 10 October 2002 and 23 January 2003 prior to the installation of the overburden migration control system. TCE results at SW-4 have never been detected above the 2,050 μg/L site-specific risk-based non-potable water screening criterion. TCE has never been detected over the 810 μg/L WQC at the SW-1 location at the property boundary.

1.5.7 Remediation System Evaluation

In 2003, the USEPA contracted a third-party consultant to conduct a Remediation System Evaluation (RSE) for the Vandalia Facility. According to program documents, the RSE involves a team of expert hydrogeologists and engineers, independent from the site, conducting a third-party evaluation of site operations. A copy of the RSE report is included in Appendix B. The RSE is a broad evaluation that considered the goals of the remedy, site conceptual model, above-ground and subsurface historical performance, and site exit strategy. The evaluation included reviewing site documents, visiting the site, and reporting that included recommendations to improve the system. Recommendations were categorized into:

- improvements in remedy effectiveness
- reductions in operation and maintenance costs
- technical improvements
- achieving site closeout

The RSE team provided in the RSE report (GeoTrans, 2003) five recommendations to enhance effectiveness. Three of the recommendations were to continue with proposed plans for: (1) piping extracted water from the overburden to the existing treatment system, (2) lowering the pump in the bedrock migration control extraction well to allow for an increased recovery rate, and (3) avoid altering the site hydrogeology that could result from sealing the connections between the Top of Rock and Sugar Rock aquifers. These three recommendations were implemented. The RSE team's fourth recommendation was to consider providing a point-of-entry treatment system for one residential property on Engle Road (see information on this property in Section 1.5.3). Delphi had been involved in ongoing discussions with this property owner before the RSE team made this recommendation. Several options had been explored to address the low level VOCs (below MCLs) detected in this well. Ultimately, the property owners moved and communication with Delphi was suspended. The final RSE team recommendation was to more fully evaluate the potential for public contact with seeps from the Sugar Rock outcrop and add signs as appropriate. This

issue was evaluated further with the USEPA. The agency agreed that given the remote location of these springs, the extremely rough terrain (the spring discharges on a nearly vertical slope) and limited access due to an active rail line, there was no need for further efforts to limit public access. Sample results collected from seeps have never been above the 2,050 μg/L site-specific risk-based non-potable water screening criterion nor above the 810 μg/L Ohio Water Quality Criteria (WQC) non-drinking water standard for human health.

To reduce costs and maintain protectiveness, the RSE team recommended modifications to the groundwater monitoring plan. The RSE proposed a more limited sampling program than was proposed in the RCRA CA750, which is currently being followed. An updated monitoring plan is discussed in Section 6 of this document. The monitoring program will be periodically reviewed and modified with agency review and approval.

One technical improvement recommendation was implemented; namely, to replace corroding pipe in the migration control treatment building. The piping has been repaired/replaced incrementally as needed.

In their review of remedial alternatives for gaining site close out, the RSE team acknowledged decades of remediation will be required and that current technologies will not likely restore the aquifer. As they evaluated remedial alternatives to address onsite DNAPL, they made the following conclusions, "the RSE team does not know of an appropriate technology that could guarantee remediation of the DNAPL at a practicable cost". When considering the offsite impacted bedrock groundwater, the RSE team provided the following assessment:

> "The area downgradient of the ground water migration control system capture zone will also likely remain well above standards for decades due to a relatively slow flushing rate of clean water through the contaminated zone and the large contaminated area. Reinjection of treated water could facilitate this flushing, but the reinjected water would disperse (not destroy the contaminants) and, due to aeration, might slow the natural reductive dechlorination that is taking place. The use of alternate technologies for this downgradient plume would also require substantial expense due to the broad area of impacts (nearly a square mile) and the cost of distributing reagents over this wide area. Assuming a radius of influence for an injection well of 50 feet, the area of influence would be approximately 10,000 square feet. Assuming a plume area of approximately one square mile (approximately 25 million square feet), approximately 50 injection wells would be required. At an estimated cost of $10,000 per injection well, the delivery costs alone would be approximately $2.5 million". **(N.B.,** ***We note some errors in the RSE discussion. An area of influence of 10,000 square feet applied to 25,000,000 square feet would require 2,500 injection wells. At $10,000 per well, this approach would cost $25,000,000*****)**. "Additional costs would be required for planning, materials, monitoring, and oversight and the results would not be guaranteed. Once the EIs are met, **the RSE team believes that an appropriate approach would be to continue operating the ground water migration control system and maintain institutional controls through the plume area**, potentially reviewing various remediation technologies on regular basis, perhaps every five years, to determine if a technology is developed that can practicably achieve aquifer restoration or other site goals" (Geotrans, 2003) (emphasis and comment added).

2. NEW DEVELOPMENTS SINCE RFI REPORT

This section presents an update with information that has been developed subsequent to completion of the RFI Report. In particular, information that could significantly affect the evaluation and selection of corrective measures alternatives is presented.

LNAPL has recently been discovered in monitoring well MW-795 which is located in the southwest corner of Building 47. An investigation to assess the source and extent of the LNAPL is currently underway. An addendum to the Corrective Measures Proposal will be prepared, if necessary, to address the significance of potential exposures to constituents of this LNAPL.

3. CORRECTIVE MEASURES EVALUATION CRITERIA AND PROCESS

The evaluation criteria and process for analysis of potential corrective measures alternatives is described in this section. RCRA established a two-phased evaluation for selection of corrective measures. The first phase screens potential remedies against three "threshold criteria" that are screening goals. Remedies that meet the threshold criteria are subsequently evaluated using seven "balancing criteria" to identify the remedy that provides the best relative combination of attributes. The threshold criteria and balancing criteria are defined in the following sections.

In conducting this corrective measures evaluation, Delphi considered the findings of the RSE Report regarding potentially applicable technologies for the site and the performance of previously implemented interim measures, and determined that a focused evaluation is appropriate. Detailed evaluation of multiple alternatives, as may have been presented in more traditional Corrective Measures Studies, is not warranted for this site. This focused approach is supported by the EPA's ANPR "Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities" (Federal Register, Vol. 61, No. 85. p. 19447), which stated:

> "EPA continues to emphasize that it does not want studies to be undertaken simply for the purpose of completing a perceived step in a perceived process. While, for a complex site, review of a full range of remedial alternatives may be required, at many sites, the preferred remedial approach will be apparent early in the cleanup process and the analysis of remedial alternatives should be highly focused."

While there may be aspects of the Facility that appear to be complex, the long and successful operation of interim measures provides clear support for a focused CMP.

3.1 Threshold Criteria

USEPA initially identified four threshold criteria for identifying remedies (USEPA "RCRA Corrective Action Plan", May 1994). USEPA subsequently recognized that the fourth criteria, "complying with applicable standards for waste management", is already required by law (USEPA, 2004). The three threshold criteria recommended by USEPA as screening tools for potential remedies are listed below:

Protect human health and the environment. Corrective measure remedies must be protective of human health and the environment. This goal is considered the primary and overarching criterion for remedy selection. Remedies may include those measures that are protective, but are not directly related to other threshold criteria (i.e., media cleanup and source control). Examples include providing alternative drinking water supplies (to eliminate potable water exposure) and other controls (to eliminate direct contact or vapor exposure).

Attain media cleanup objectives. Corrective measure remedies should strive to attain media cleanup objectives, which may incorporate specific media cleanup levels and points of compliance. Attaining media cleanup objectives does not necessarily entail removal or treatment of all contaminated media above specific constituent concentrations. Corrective

measures may attain media cleanup objectives through various combinations of removal, treatment, engineering controls and institutional controls. Media cleanup objectives may be derived from existing regulations or from site-specific risk assessments. Media cleanup objectives should reflect the potential risks of the Facility and media by considering the toxicity of the constituents of concern, exposure pathways, and fate and transport characteristics. The media cleanup objectives often play a large role in determining the extent of a remedy and technical approaches to a remedy.

Control the source(s) of releases to reduce or eliminate, to the extent practicable, further releases of hazardous waste (including hazardous constituents) that may pose threats to human health and the environment. A critical objective of corrective action is to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health or the environment. An effective source control program ensures the long-term effectiveness and protectiveness of the corrective measure. Protective source control remedies include capping/containment, groundwater migration control, and partial waste removal. Technical limitations may be encountered in achieving effective source control. In case of technical limitations in achieving source control, source controls may need to be combined with other measures, such as plume management or exposure controls, to ensure an effective and protective remedy.

3.2 Balancing Criteria

Seven balancing criteria can also be considered when evaluating a corrective measure that meets the three threshold criteria. The following balancing criteria represent a combination of technical measures and management controls for addressing environmental solutions:

Long-term reliability and effectiveness. Demonstrated and expected reliability of a corrective measure remedy is a way of assessing the risk and effect of failure. Evaluation of alternative remedies may consider whether the technology (or combination of technologies) has been used effectively under similar site conditions. This is particularly important when considering in-situ technologies. The evaluation also considers whether failure of any one component would have an immediate impact on receptors, and whether the alternative would have flexibility to adapt to uncontrollable changes (e.g., heavy rain storms) at the site. USEPA recognizes that most corrective measure technologies deteriorate over time, with the exception of destruction or removal technologies. Deterioration may be managed through proper operation and maintenance; however, some technology systems may require replacement. Therefore, each corrective measure alternative should be evaluated in terms of the projected useful life of the overall alternative and of its component technologies. Useful life is defined as the length of time during which the level of effectiveness can be maintained.

Reduction in the toxicity, mobility or volume of wastes. In simple settings where contaminants are readily accessible, remedies capable of eliminating or substantially reducing the potential for wastes to cause future releases or other risks may be deployed. However, at large active industrial sites, particularly where chlorinated solvents have been released, achieving substantial reductions in toxicity, mobility or volume may not be practicable.

Short-term effectiveness and short-term risks. Corrective measures alternatives may offer varying levels of human health and environment protection during the construction and

implementation of a remedy until corrective action objectives have been met. Short-term effectiveness may be particularly relevant and beneficial when corrective measures will be conducted in populated areas, or where special protective measures are necessary to control current risks. The risks posed to workers and the community during remedy implementation can be evaluated either qualitatively or quantitatively, depending on conditions at the site. A quantitative evaluation of short-term risks is most likely to be useful when the types, levels and/or exposure of hazardous substances are expected to change significantly as a result of remediation.

Implementability. The ease of remedy implementation is often a determining factor in evaluating corrective measures alternatives. Implementability is assessed by considering the following factors: administrative activities such as permits, rights of way, off-site approvals and the time consumed by these activities; constructability, time for implementation, and time for beneficial results; availability of adequate off-site treatment, storage capacity, disposal services, necessary technical services and materials; and availability of prospective technologies for each corrective measure alternative.

Cost. Relative cost of a remedy is an appropriate consideration where several different technical alternatives for remediation will offer equivalent protection but may vary widely in cost. In those situations where only one remedy is proposed, the issue of cost would not need to be considered. Cost estimates could include costs for engineering, site preparation, construction, materials, labor, sampling/analysis, waste management/disposal, permitting, health and safety measures, training, operation and maintenance, etc. For cost comparisons between alternatives to be accurate, USEPA recommends they should include capital costs plus operation and maintenance costs for the anticipated life of the remedy, and the net present value of these costs.

Community acceptance. Corrective measures alternatives comparisons should consider the degree to which remedies will be acceptable to the surrounding community

State acceptance. Corrective measures alternatives comparisons should consider the degree to which remedies will be acceptable to the State in which the Facility is located. This balancing criterion is reserved for USEPA.

It is noted that the last two balancing criteria (community and State acceptance) were not explicitly stated in the May 1, 1996 Advanced Notice of Proposed Rulemaking (USEPA, 1996a); however, USEPA's subsequent "Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action" April 2004 (USEPA, 2004) recommended including these criteria as important considerations.

3.3 Evaluation Process

USEPA advises RCRA facility owners/operators to focus their corrective measures evaluation on realistic remedies, and recognizes that some potential remedies should not be considered because they are simply not practicable. The Agency also recognizes that at many sites, the preferred remedial approach will be apparent early in the process; in such cases, the analysis of remedial alternatives should be highly focused (USEPA, 1996a).

USEPA has learned (USEPA, 1996a) that certain combinations of site-specific circumstances are often addressed by similar corrective measures approaches. Based on their experience, USEPA has developed certain expectations for remedies. These remedial expectations allow RCRA facility owners/operators to focus resources on the most practicable corrective measures alternatives. EPA expectations include the following:

- Use treatment to address principle threats such as contamination that is highly toxic, highly mobile, or cannot be reliably contained.
- Use engineering controls for wastes that can be reliably contained, pose relatively low long-term threats, of for which treatment is impracticable.
- Use a combination of methods (e.g., treatment, engineering controls and institutional controls), as appropriate, to achieve protection.
- Use institutional controls primarily to supplement engineering controls to prevent or limit exposure; institutional controls will not often be the sole corrective measure.
- Consider using innovative technology.
- When restoration of groundwater is not practicable, prevent or minimize further plume migration, prevent exposure to groundwater, and evaluate further risk reduction. Control or eliminate sources of groundwater contamination.
- Remediate contaminated soils as necessary to prevent or limit direct contact exposure, and prevent the transfer of unacceptable concentrations from soils to other media.

4. CORRECTIVE MEASURES ALTERNATIVES

General corrective measures are media-specific response actions, such as institutional controls, engineering controls, monitoring, in-situ or ex-situ groundwater treatment, source removal, and in-situ or ex-situ soil treatment, which satisfy the corrective action objectives. This section generically introduces the general corrective measures that are potentially applicable to media of concern at the Facility. Site-specific screening of these general corrective actions will proceed in Section 5.

In conformance with the performance-based Order and the 1996 EPA Advance Notice of Proposed Rulemaking (ANPR) (61 FR 19432), Section 5 presents proposed corrective measures for the Facility. Detailed evaluation of multiple alternatives for each AOI, as may be expected in a more formal Corrective Measures Study, is not provided. This focused approach is supported by the EPA's ANPR "Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities" (Federal Register, Vol. 61, No. 85, p 19447), which states "EPA continues to emphasize that it does not want studies to be undertaken simply for the purpose of completing a perceived step in a perceived process. While, for a complex site, review of a full range of remedial alternatives may be required, at many sites, the preferred remedial approach will be apparent early in the cleanup process and the analysis of remedial alternatives should be highly focused". While there may be aspects of the Vandalia site that appear to be complex, the long and successful operation of interim measures provides clear support for a focused CMP.

Delphi has focused on risk mitigation through interim measures since assuming control of the Facility in 1999. The effectiveness of the existing interim measures has been thoroughly evaluated and is well documented. The 2003 CA725 Human Health Environmental Indicator Report demonstrated that all human exposures were under control under current conditions. The 2004 CA750 Groundwater Stabilization Environmental Indicator assessment demonstrated that migration of "contaminated waters" was under control. Both Environmental Indicators received positive determinations from USEPA soon after their completion dates in 2003 and 2004. The June 2003 RSE report supported the interim measures program for the facility. When considering longer-term options for site restoration, the RSE team recommended continuing operation of existing interim measures.

Corrective measure alternatives are considered that could be incorporated into a remedial strategy that mitigates the potential for unacceptable exposures. As discussed in Section 1.3.2, the risk evaluations conducted during the RFI identified potential unacceptable exposures associated with (1) direct contact and potential migration of on-site VOC-impacted overburden groundwater, (2) potential use of off-site VOC-impacted bedrock groundwater, and (3) potential vapor intrusion to indoor air from soil and shallow groundwater. Options to address these issues will be presented below. A more detailed comparison, including an AOI-specific discussion is presented in Section 5.

The RFI also identified VOC-impacted soils in AOI-15/AOI 50, LNAPL and DNAPL as potential sources of dissolved-phase constituents to groundwater. The DNAPL recovery interim measure effectively removed free/potentially mobile DNAPL from the subsurface at the facility. USEPA recently acknowledged, in its April 2006 comments to the January 2006

CMP that further remedial action for DNAPL would not be practicable due to the nature of the DNAPL itself, the complexity of the site (subsurface appurtenances, location of DNAPL with respect to site buildings and depth of DNAPL) and the fact that residual DNAPL will likely exist after remediation. Similarly, further corrective measures to address soils that could contribute to a dissolved-phase plume in and adjacent to areas affected by residual DNAPL would not mitigate risk or help to restore the site and will therefore not be considered. As described in Section 2, LNAPL is being addressed with further site investigation and is therefore not being considered in this CMP.

4.1 Institutional Controls

Institutional controls (ICs) are non-engineered instruments such as administrative and/or legal controls that minimize the potential for human exposure by limiting land or resource use. ICs are generally used in conjunction with engineering measures such as treatment or containment. USEPA recommends that ICs be "layered" (i.e. use multiple ICs simultaneously) or implemented in a series to provide overlapping assurances of protection. Some examples of ICs include easements, covenants, well drilling prohibitions, zoning restrictions, and special requirements for building permits.

There are four categories of ICs:

- Governmental Controls
- Proprietary Controls
- Enforcement and Permit Tools
- Informational Devices

4.1.1 Governmental Controls

Governmental controls, implemented by state or local government, include zoning restrictions, ordinances, statutes, building permits, or other provisions that restrict land use or resource use at the Facility. Groundwater use restrictions and bans on fishing or swimming are common examples of governmental controls. Delphi is actively assisting the City of Vandalia with development of an ordinance that will restrict future groundwater use in the area. A similar use restriction will be pursued with Butler Township.

4.1.2 Proprietary Controls

Proprietary controls are based on real-property law and generally create legal property interests. These controls may include easements and covenants, and involve legal instruments placed in the property chain-of-title. These controls are generally more reliable in the long term than other types of ICs because they transfer with ownership of the land.

Delphi will modify the deed of its current Vandalia property holdings to include a restriction on groundwater use, limit the future land use to industrial/commercial and impose controls on excavation procedures. These deed restrictions will be memorialized through the Ohio Environmental Covenants Act.

In addition, several residents in the Cassel Road area have modified their deeds to include restrictions on future groundwater use.

4.1.3 Enforcement and Permit Tools

Under RCRA, unilateral administrative orders and administrative orders by consent can be issued or negotiated to compel the landowner to limit certain activities at the Facility. Consent decrees can also be negotiated. However, most enforcement agreements are only binding on the signatories, and the property restrictions are not necessarily transferred with ownership.

It is assumed that following the Statement of Basis, the existing Administrative Order on Consent or an implementation order will be amended/established to reflect environmental covenants and other ICs. This order would obligate Delphi or its successors to maintain, monitor and enforce the established ICs or be subject to enforcement elements stipulated in the order.

4.1.4 Informational Devices

Informational tools provide information or notification that residual contamination or capped contamination may remain at a site. Common examples are state registries of contaminated properties, deed notices and advisories. Informational devices are most likely used as a secondary "layer" to bolster the reliability of other ICs.

As mentioned previously, Delphi intends to modify the deeds for any properties they hold in the potentially impacted area as informational devices for potential future owners. In addition, Delphi plans to distribute periodic public advisories to remind residents of ordinances that restrict groundwater use.

4.2 Monitoring

Corrective measures include any monitoring that is reasonably required to ensure that the remedy protects the public health, welfare, and the environment. Details of the Facility monitoring plan are presented in Section 6.

4.3 Groundwater Extraction and Ex-Situ Treatment

There are a number of technologies for each of the groundwater collection, ex-situ treatment and discharge components of this corrective measure. Collection technologies may include extraction wells and permeable interceptor trenches. For treatment, there are physical/chemical and biological technologies. Discharge of water that has been treated may be to surface water through an NPDES permit, to a local POTW, to a commercial treatment/storage/disposal facility, or by reinjection to the aquifer. Groundwater removal may be performed to hydraulically control the migration and extent of contamination. In addition, groundwater removal may also be performed to remove contaminant mass. Groundwater pump-and-treat is the representative technology that was selected for further evaluation in Section 5.

4.4 In-Situ Groundwater Treatment

There are a number of in-situ groundwater treatment technologies. A representative in-situ groundwater treatment technology, injection of amendments to enhance aquifer conditions for contaminant biodegradation, is an alternative for groundwater restoration. This technology enhances natural degradation processes by providing additional electron acceptors or donors, nutrients, or other constituents that may be limiting the natural processes. Injection of amendments to groundwater is typically performed through wells on a grid pattern or in a barrier arrangement to maximize distribution and effectiveness. Aquifer characteristics such as flow rate, porosity and soil type affect not only the placement of injection points, but also the amendment volume. In some circumstances, multiple injections of amendments may be necessary to effectively meet corrective measure objectives. Enhanced bioremediation through injection of amendments is the representative technology that was selected for further evaluation in Section 5.

4.5 Source Removal

Source removal technologies include soil excavation and soil vapor extraction, two representative technologies selected for further evaluation in Section 5.

Removal of impacted soils by common soil excavation methods is a potential corrective measure for unsaturated soils (i.e. soils above the water table). Excavated soil subsequently requires treatment and/or disposal. When soils are treated/disposed off site, the excavated area must generally be backfilled with imported earthen materials suitable for the future use of the area. Site restoration may also be required. Soil excavation may require side wall sheeting and shoring to protect adjacent structures.

Removal of VOCs in soil vapor at locations above the water table is known as soil vapor extraction (SVE), soil venting or vacuum extraction. This in-situ remedial technology is accomplished by inducing a negative air pressure gradient through horizontal or vertical wells to mobilize volatile contaminants. Mobilized VOCs are drawn into the wells, collected, treated as necessary and the air stream is subsequently discharged to the atmosphere. SVE technology has also been effectively used to prevent VOCs from migrating through building foundations and floor slabs into occupied building spaces. SVE generally induces a significant vacuum with a sizeable blower. SVE accomplishes both source removal and mitigation of vapor intrusion.

4.6 Indoor Air Mitigation

Abatement strategies for mitigating potential vapor migration into buildings include sealing the building envelope (e.g., vapor barriers), installing subslab ventilation systems, and/or modifying building ventilation to increase air exchanges and/or lower indoor/outdoor pressure differentials.

A representative indoor air mitigation technology is sub-slab depressurization. This variation of soil vapor extraction induces a negative pressure at or immediately below a building foundation to prevent vapor migration into the building. This application of SVE technology typically focuses on mitigating vapor migration and not on source removal; however, some

removal will be accomplished at a slower rate. Sub-slab depressurization generally induces only a slight vacuum, often with a simple fan. This representative technology will be evaluated further in Section 5.

5. EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

In this step of evaluating corrective measures alternatives, potentially applicable technologies were identified and screened with respect to the three RCRA threshold criteria, and subsequently evaluated with respect to the seven balancing criteria. This evaluation was performed for each area where the RFI identified specific constituents that contributed most significantly to risk estimates exceeding the acceptable risk thresholds; namely, specific AOIs, and groundwater, including both overburden groundwater and bedrock groundwater. In each of the following sections, the area is briefly described, and the corrective measures alternatives are evaluated with regard to the threshold and balancing criteria. Alternatives considered for a given area were evaluated relative to each other with respect to the balancing criteria. Balancing criteria are not comparable for alternatives between different areas.

Risk assessments performed during the RFI identified areas where concentrations of hazardous constituents in environmental media pose a potential for current or future unacceptable risk. The risk assessments were based on the following assumptions: (1) future land use will remain commercial/industrial; (2) on-site groundwater will not be used; and (3) the current Facility Excavation Policy prevents unacceptable exposures to groundwater and residual DNAPL. Because the conclusions of the RFI rely, in part, on these assumptions, institutional controls are proposed to maintain the current land use, groundwater use and Excavation Policy. These institutional controls are Facility-wide and are integral components of all potential corrective measures alternatives that are subsequently evaluated.

A summary of the alternatives identification and screening is shown on Table 1; the threshold and balancing criteria are evaluated for each potential alternative for each area of interest. A more-detailed summary of the cost evaluation for various alternatives is included on Table 2.

5.1 AOI 15/AOI 50

Cis-1,2-dichloroethene and TCE concentrations in soil were identified as contributing significantly to the predicted risks for the soil vapor intrusion pathway in this area. Concentrations of TCE in soil were also identified as representing a potential continuing source of shallow groundwater contamination. The affected area is inside Building 31, beneath a concrete floor slab, in an area with structural support columns, adjacent to the East Tunnel. The affected area is 4,500 square feet. The groundwater table is encountered at a depth of approximately 12 feet in this area at the bottom of the tunnel, which has historically been dewatered.

Three alternatives were evaluated for additional corrective measures at AOI 15/AOI 50; namely, two active remediation technologies, and one engineering control. In addition, the Facility-wide institutional controls are integral components of all potential corrective measures alternatives. The active remediation technologies are soil excavation and soil vapor extraction. The engineering control is for the Facility building; namely, operation of the Facility HVAC system, or equivalent, when the building is occupied to mitigate the adverse impacts from potential vapor migration.

Excavation Alternative

For the excavation alternative, major components include demolition of the concrete floor, column support, excavation dewatering, excavation sheeting and shoring, backfilling, and replacement of the concrete floor. Soil would be excavated and transported off site for treatment/disposal. The implementation schedule is estimated at six months for design, pre-construction planning and implementation. There are no subsequent operation and maintenance components.

With regard to threshold criteria, this technology is protective and achieves media cleanup objectives because soil constituents that contribute to potentially unacceptable risks or continue as a source of groundwater contamination are immediately removed. The historical source of the release at this area has been eliminated; there are no further releases. On a Facility-wide basis, excavation and removal of a relatively small volume of contaminated soil has limited effect on long-term improvements in groundwater quality.

With respect to balancing criteria, this technology has high long-term reliability and effectiveness because unacceptable concentrations of soil constituents are permanently and verifiably removed. This technology results in a high reduction of the waste volume because soil constituents are removed. This technology has the highest short-term effectiveness because of the short amount of time to complete excavation. This technology has moderate implementability because of its complicating demolition, underpinning and construction elements. This technology has the highest cost. Community acceptance is not anticipated to be a differentiator for excavation at the Facility.

Soil Vapor Extraction Alternative

For the SVE alternative, major components include four extraction wells (4-inch diameter, 12-feet deep), header pipe, regenerative blower (50-inch water vacuum, 200 cubic feet per minute), and air treatment by carbon adsorption. The implementation schedule is estimated at four months for design, drilling and equipment installation. Subsequent operation and maintenance include blower maintenance and periodic carbon recharge.

With regard to threshold criteria, this technology is protective and achieves media cleanup objectives because soil constituents that contribute to potentially unacceptable risks or continue as a source of groundwater contamination are removed over time. The historical source of the release at this area has been eliminated; there are no further releases. On a Facility-wide basis, extraction of a relatively small volume of contaminants in soil has limited effect on long-term improvements in groundwater quality.

With respect to balancing criteria, this technology has medium long-term reliability and effectiveness because soil constituents are removed; however, not as reliably as they are by excavation. In addition, mechanical systems depend on power, O&M and component life. This technology results in a medium reduction of the waste volume because SVE will take more time than excavation to achieve results. This technology has medium short-term effectiveness because of the longer amount of time to take effect. This technology has moderate implementability because of its complicating indoor drilling and construction elements. This technology has medium cost. Community acceptance is not anticipated to be a differentiator for SVE at the Facility.

Engineering Control - Operate HVAC (Facility)

With regard to threshold criteria, this engineering control is protective in combination with ICs because it reduces potential exposures to unacceptable indoor air concentrations; air concentrations at levels posing a potentially unacceptable risk are prevented from developing from inside the building. This engineering control attains media cleanup objectives in combination with ICs because it reduces potential exposures. The historical source of the release at this area has been eliminated; there are no further releases.

With respect to balancing criteria, this engineering control has medium long-term reliability because it is required by building code; and mechanical systems depend on power, O&M, and component life. This engineering control results in low reduction of waste. This engineering control has high short-term effectiveness because of the short amount of time to implement and take effect. This alternative has easy implementability when compared to technologies such as excavation and SVE. This alternative has low cost. Community acceptance is not anticipated to be a differentiator for engineering controls at the Facility.

Recommended Final Corrective Measures AOI 15/AOI 50

Based on the preceding evaluation of corrective measures alternatives, the recommended final corrective measures for AOI 15/AOI 50 are the combination of continued operation of the Facility HVAC system, or equivalent, with the Facility-wide industrial land use restriction, groundwater use prohibition (such that migration of VOCs from soil to shallow groundwater do not result in unacceptable groundwater exposures), and the implementation of the Facility's excavation policy. Together, this combination of an engineering control and institutional controls is most appropriate because it is highly effective in the short term, more easily implemented, and significantly less expensive than the other evaluated alternatives. In addition, the recommended corrective measures utilize existing infrastructure, do not change existing conditions, or create additional inadvertent migration pathways by disturbing the existing concrete.

Due to residual VOC concentrations in shallow overburden groundwater, implementation of source removal alternatives in soil would not substantially change the need for or duration of institutional and engineering controls for this area. Evaluation of corrective measures for overburden groundwater is presented in Section 5.4.1.

5.2 AOI 43

Naphthalene and 2-methylnaphthalene concentrations in soil were identified as contributing significantly to the predicted risks for the soil vapor intrusion pathway in this area. In addition, potentially unacceptable concentrations of 2-methylnaphthalene, naphthalene and 1,2,4-trimethylbenzene were detected in indoor air during a period of Facility shut-down. The affected area is inside Building 31 straddling the north wall, beneath a concrete floor slab, in an area with structural support columns. The combined affected area is 1,400 square feet. The groundwater table is encountered at a depth of approximately seven feet in this area.